(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(54) Title: OPTIMISED ROUTING OF MOBILE CALLS
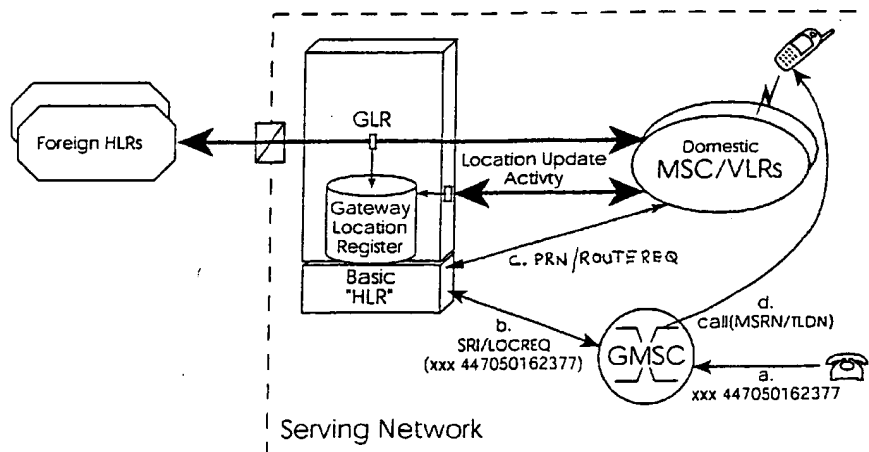
(57) Abstract: A platform for a GLR routes calls to a roamer in its (visited) network directly to the roamer. This avoids routing of calls to the roamer's home network and back again to the visited network, thus avoiding international call charges for the links between the home and visited networks. The GLR translates the called number (for example, by removing a special optimised routing suffix) into a real identifier of the roamer and uses this identifier to query for routing information.

"Optimised routing of mobile calls"

INTRODUCTION

5   Field of the Invention

The invention relates to routing of calls in an optimum manner.

Prior Art Discussion

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When a roaming subscriber roams into a visited network, people in the visited network area can call the roaming subscriber. However, they must use the subscriber's international number and, therefore, must pay international call charges for a link to the roamer's home network. Furthermore, the roamer pays for an

15   international call from the home network back into the visited network.

The invention is directed towards addressing this problem.

SUMMARY OF THE INVENTION

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According to the invention, there is provided a method for optimising routing of a call from a caller to a roamer in a visited mobile telecommunication network, the method comprising the steps of:-

25   the caller dialling an optimised routing number of the roamer which is
             different from the roamer's home network number; and

             the visited network recognising the optimised routing number as one for a
             roamer possibly in its domain and routing the call directly to the roamer

30   without incurring call charges for a call to or from the home network.

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In one embodiment, the method comprises an initial notification step of the visited network transmitting a notification message with optimised routing information to the roamer when she initially roams in the visited network.

5

In another embodiment, the method comprises the additional step of the visited network performing call forwarding.

In one embodiment, the visited network updates a GLR to indicate that the roamer is roaming in the visited network and the step of the visited network routing the call to the roamer comprises:-

a GMSC using the called number to query the GLR for routing information;

15   in response to the query, the GLR determining routing status and number and returning them to the GMSC; and

the GMSC calling the roamer.

20   In one embodiment, the visited network automatically marks an entry in the GLR as inactive when the roamer leaves the visited network.

In one embodiment, the GMSC queries the GLR in a manner equivalent to querying a HLR.

25

In another embodiment, the GLR initially determines roaming status according to an internal database, and it determines the routing number by querying an MSC or a VLR.

In a further embodiment, the optimised routing number comprises a number derived from the roamer's home network number and a prefix.

In one embodiment, the optimised routing number comprises a permanent virtual

5   national number registered with the visited network and cross-referenced to a home identifier.

In another embodiment, the visited network maintains configuration data indicating whether and how to re-direct a call.

10

In one embodiment, the call is in the form of a short message.

In one embodiment, an SMSC of the visited network makes a routing information query from a GLR, the GLR determines routing information and returns it to the

15   SMSC, and the SMSC forwards the short message to the roamer.

According to another aspect, the invention provides a mobile telecommunication network system comprising means for routing as described above.

20   In one embodiment, a signal relay layer comprises means for monitoring signal traffic according to filter criteria to update a guest location register to provide routing information

DETAILED DESCRIPTION OF THE INVENTION

25

Brief Description of the Drawings

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only with reference to the

30   accompanying drawings in which:-

Fig. 1 is a diagram illustrating a system of the invention and its interactions with components of its network and foreign network;

5   Figs. 2, 3, and 4 are diagrams showing signal interactions for operation of the system; and

Fig. 5 is a diagram showing an alternative system of the invention.

10   Description of the Embodiments

When a mobile subscriber ("roamer") is roaming in another network, the visited network ("VPLMN"), calls to the roamer are normally routed via her home network ("HPLMN"). The roamer pays international roaming charges for the incoming call

15   for the leg between the home network and the visited network. If the call originates in the serving visited network, this means that not only does the roamer pay roaming charges, but also the caller pays an international rate to the home network.

In this invention the caller dials an optimised routing number that causes the call to

20   be handled by the visited network. Using its knowledge of roaming subscribers served by it, the network then routes calls for such subscribers directly rather than using the standard routing to the home network. The invention thus provides roamers local cost routing while roaming and no involvement of the subscriber's home network is required. The following are two examples.

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Example 1

Optimised Routing Prefix Service

- 5 -

The roamer is given a national number whilst roaming in the visited network. This national number is derived from the roamer's foreign identity, for example by addition of a carrier selection prefix. Calls made to the national number are routed directly to the roamer if she is roaming in the visited network.

5

A subscriber is able to prevent any calls being directly routed using this service. A USSD string (GSM) or feature code (ANSI 41) is available to turn on or off the capability. By default the service is normally turned on.

10   Example 2

Virtual National Number (VNN) Service

The subscriber has a permanent visited network national number that may be used
15   by anyone in the visited network area to call the subscriber. When this national number is called the network maps it to the subscriber's foreign identity number and checks if the roamer is in the visited network. If so, it forwards the call to the roamer, or otherwise it forwards the call to the home network. The subscriber has an independent account with the visited network operator which is charged as
20   necessary.

The number (MSISDN/MDN) is "virtual" in that there is no associated IMSI/MSID and, in GSM no SIM card.

25   Notifications

The optimised routing service could include the use of short messages or network originated USSD strings to welcome the subscriber to the network and summarise the service. USSD strings are preferred as they require no subscriber action to view

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them.   Other messages, such as advice of cost savings may be generated by operations support systems from analysis of CDRs, etc.

Call Forwarding Supplementary Services

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Supplementary services may be offered to a roamer called via the service of the invention.   In principle, any supplementary service will continue to be available, provided it is performed solely by the VPLMN and would not involve unexpected charges or non-standard charge reconciliation between operators.

10

It is possible to include local call forwarding services when the subscriber is called. This is particularly convenient using the VNN service.   However, apart from unconditional call forwarding, these services cannot be available when the subscriber is not roaming in the network.

15

Service Control

In GSM networks it is possible to control aspects of the optimised routing service using USSD strings.   This includes disabling (and enabling) the prefix service.   Other
20   capabilities include setting unconditional call forwarding for the VNN service.   For ANSI 41 networks special feature codes are used.   However, because these are not standardised, the actual codes that would be available need to be defined by the operator.

25   Referring to Fig. 1, the optimised routing service is implemented in a system which is an extension to the Gateway Location Register (GLR) architecture set out in the 3GPP standards.   The basic GLR maintains a register of roaming subscribers.   The information in this register is the basis for the optimised routing services.   The GLR provides HLR functionality to roamers.

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A caller makes a call in a signal "a", with the called number being a prefix xxx followed by the roamers home network number.

A network's (gateway) MSC queries the GLR (from its perspective, the HLR) for
5   routing information with a signal "b" incorporating this number. In GSM a Send_Routing_Information (SRI) operation is used; in ANSI 41 it is a *LOCREQ*. The system translates the directory number (MSISDN or MDN) used in this query to the roaming subscriber's real identity, which it can use to determine the subscriber's roaming status. For the prefix service, the translation is simply algorithmic (for
10   example, removing the prefix). However for the virtual national number service, a mapping database is used. This mapping database is in the form of permanent entries in the GLR, with the appropriate data packages.

If the subscriber is believed to be roaming in the visited network the location
15   information in the GLR is used to query the serving MSC/VLR with a signal "c". In GSM this is a Provide_Routing_Number (PRN) operation which returns the routing number (MSRN); in ANSI 41 the operation is ROUTEREQ and the routing number is known as a TLDN.

20   If the roamer is not found in the GLR's cache, or the location information seems incorrect, the resulting action will depend on the service (in the simplest case the call will just fail).

Finally, if the roamer is in the network, the call is set up with a signal "d".
25

In more detail, a call is made using the appropriate numbering plan to achieve optimised routing. This call is routed into the network (or, if mobile originated, will already be in the network). The numbering plan used will be operator and service-specific. The call is routed to a (G)MSC in the visited network, which determines
30   that a query to the system is needed. In Fig. 1, the carrier selection routing prefix

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method is shown. The GMSC treats the system as the HLR for that number, and requests routing information with an appropriate MAP operation. The routing number returned in the result is used to set up the call. The prefix used or the national numbers should be sufficient to determine the charge appropriate to the

5 calling party. It is recommended that the service is totally "calling party pays" as that avoids any billing and charge reconciliation problems.

Termination of Roaming

10 The GLR detects termination of roaming and marks entries as inactive and, if they are temporary, eventually removes them. When an entry has been marked as inactive, no further calls using optimised routing will be possible, until a new registration is detected. If during call set-up an inconsistency (for example, a query to a supposed VLR failed), is detected, the effect would be the same as if the entry in

15 the GLR were marked as inactive.

Action if Subscriber is Not Roaming in Network

If an optimised call is attempted when a subscriber is identified as not roaming in the

20 serving network, the action taken will depend on the service and on the requirements of the operator.

Prefix Service

25 The optimised routing prefix service has no subscribers as such. It is not, therefore, possible or reasonable for there to be any form of called party paid services initiated by arbitrary networks. It is, therefore expected that if the subscriber is not actively roaming in the serving network, the calls should be terminated. As an option, termination could be achieved by routing to the number of an IVR system that would

30 play an appropriate announcement.

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Virtual National Number Service

For the virtual national number service, as the roamer will also be a subscriber of the
5   serving network (to the VNN service), it is possible to charge the national number
account for services such as onward routing. Thus if the subscriber is not roaming in
the serving network, it is an option to redirect a call to the real directory number of
the subscriber using a signal "d", charging the subscriber for the onward leg. This is
shown in Fig. 2.
10

If the home network supports the service for optimised routing, this redirection could
be made more efficient, as the serving network could query the HLR directly (with
an *SRI-SOR* operation). However the end result from the subscriber's perspective is
the same.
15

For the VNN service, configuration and subscriber data includes options on whether
and how to redirect a call when the subscriber is not roaming in the serving network.

Short Message Delivery from Operator's SMSC
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For the virtual national number service, it is possible that the national number may
be used as a destination address for short messages and, in the longer term, other
non-call related signalling such as any-time-interrogation and location services. The
approach is that a short message gateway function is used that maps between the
25   national identity and the foreign identity.

Alternatives are:-

- 10 -

1. The system translates the virtual national number to the subscriber's real HLR and relays (SCCP relay) the message to the home HLR with a signal "b". The home network responds directly to the SMSC which can then forward the message to the subscriber wherever she is. This is shown in Fig. 3.

5

2. The system determines that the subscriber is roaming in the serving network and returns appropriate routing information directly using a mapping database. This is shown in Fig. 4.

10 VNN Account Disabling

The data package associated with the VNN service includes fields to enable the account to be temporarily disabled. These fields are similar to those in an HLR. The account can either be totally disabled, in which case most call processing is as though the entry were not found, or it can be disabled from chargeable events, such as
15 redirection or call forwarding.

Deployment

20 From the network's perspective, the system is deployed as an HLR handling international MAP traffic from the domestic network entities (MSCs/VLRs, SMSCs, etc). Location update and related operations from domestic VLRs are routed through the system. Similarly, responses to such operations and operations sent autonomously by roaming subscribers' HLRs must also pass through the system.
25 Domestic signalling traffic and signalling traffic associated with subscribers roaming in other networks will not be handled by the GLR. For the simple HLR functions, the system has appropriate point codes (and global title) sub-system numbers.

In an alternative implementation illustrated in Fig. 5 the signalling traffic associated
30 with incoming roamers is monitored using a signalling relay function. From the

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monitored signalling a Guest Location Register is maintained. The information maintained in this Register, and the call processing logic for mobile terminated call and short message delivery is the same as described above. Another alternative technical architecture is to tap the SS7 links in a non-intrusive manner. The system would still act as an end node for working as an HLR. The main advantage is that as the monitoring is non-intrusive, there is no impact on the main functions of the network in the event of total failure of the platform.

The invention is not limited to the embodiments described but may be varied in construction and detail. For example the various functions described above for use with the VNN service may alternatively be implemented where the optimised routing number is of the type having a prefix. This may involve the system managing the "prefix" type optimised routing number in a manner whereby the roamer is permanently or temporarily a subscriber.

Claims

1.   A method for optimising routing of a call from a caller to a roamer in a visited
     mobile telecommunication network, the method comprising the steps of:-

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     the caller dialling an optimised routing number of the roamer which is
     different from the roamer's home network number; and

     the visited network recognising the optimised routing number as one for a
10   roamer possibly in its domain and routing the call directly to the roamer
     without incurring call charges for a call to or from the home network.

2.   A method as claimed in claim 1, wherein the method comprises an initial
     notification step of the visited network transmitting a notification message
15   with optimised routing information to the roamer when she initially roams in
     the visited network.

3.   A method as claimed in claim 1 or 2, wherein the method comprises the
     additional step of the visited network performing call forwarding.

20

4.   A method as claimed in any preceding claim, wherein the visited network
     updates a GLR to indicate that the roamer is roaming in the visited network
     and the step of the visited network routing the call to the roamer comprises:-

25   a GMSC using the called number to query the GLR for routing information;

     in response to the query, the GLR determining routing status and number and
     returning them to the GMSC; and

30   the GMSC calling the roamer.

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5.   A method as claimed in claim 4, wherein the visited network automatically marks an entry in the GLR as inactive when the roamer leaves the visited network.

6.   A method as claimed in claim 4 or 5, wherein the GMSC queries the GLR in a manner equivalent to querying a HLR.

7.   A method as claimed in claim 4, 5, or 6 wherein the GLR initially determines roaming status according to an internal database, and it determines the routing number by querying an MSC or a VLR.

8.   A method as claimed in any preceding claim, wherein the optimised routing number comprises a number derived from the roamer's home network number and a prefix.

9.   A method as claimed in any of claims 1 to 7, wherein the optimised routing number comprises a permanent virtual national number registered with the visited network and cross-referenced to a home identifier.

10.   A method as claimed in any preceding claim, wherein the visited network maintains configuration data indicating whether and how to re-direct a call.

11.   A method as claimed in any preceding claim, wherein the call is in the form of a short message.

12.   A method as claimed in claim 11, wherein an SMSC of the visited network makes a routing information query from a GLR, the GLR determines routing information and returns it to the SMSC, and the SMSC forwards the short message to the roamer.

13. A mobile telecommunication network system comprising means for routing as claimed in any preceding claim.

5 14. A system as claimed in claim 13, comprising a signal relay layer comprising means for monitoring signal traffic according to filter criteria to update a guest location register to provide routing information.

15. A computer program product comprising software code for performing the
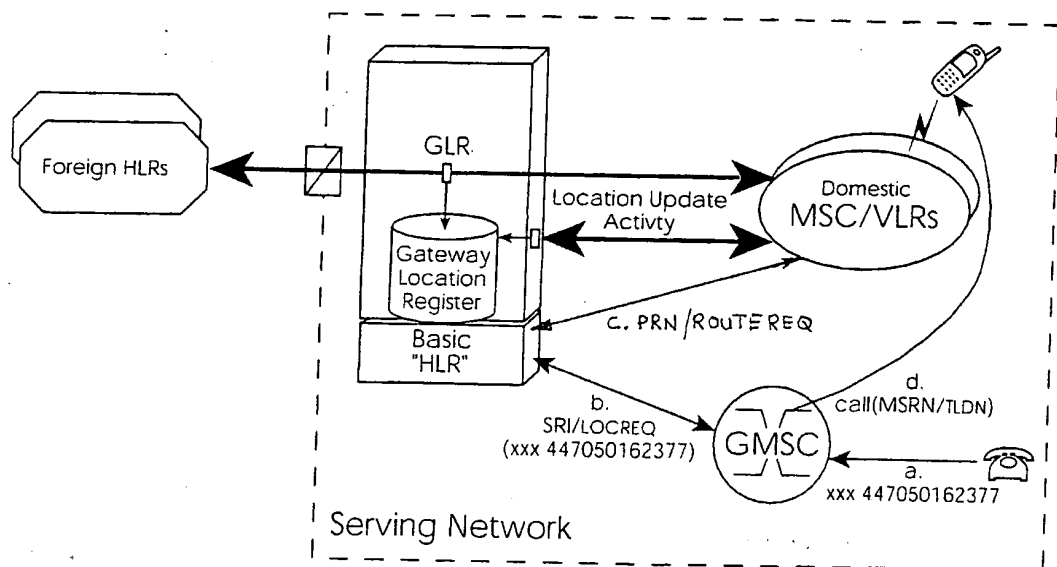10 routing steps of any of claims 1 to 12 when executing on a digital processor of a mobile network element.
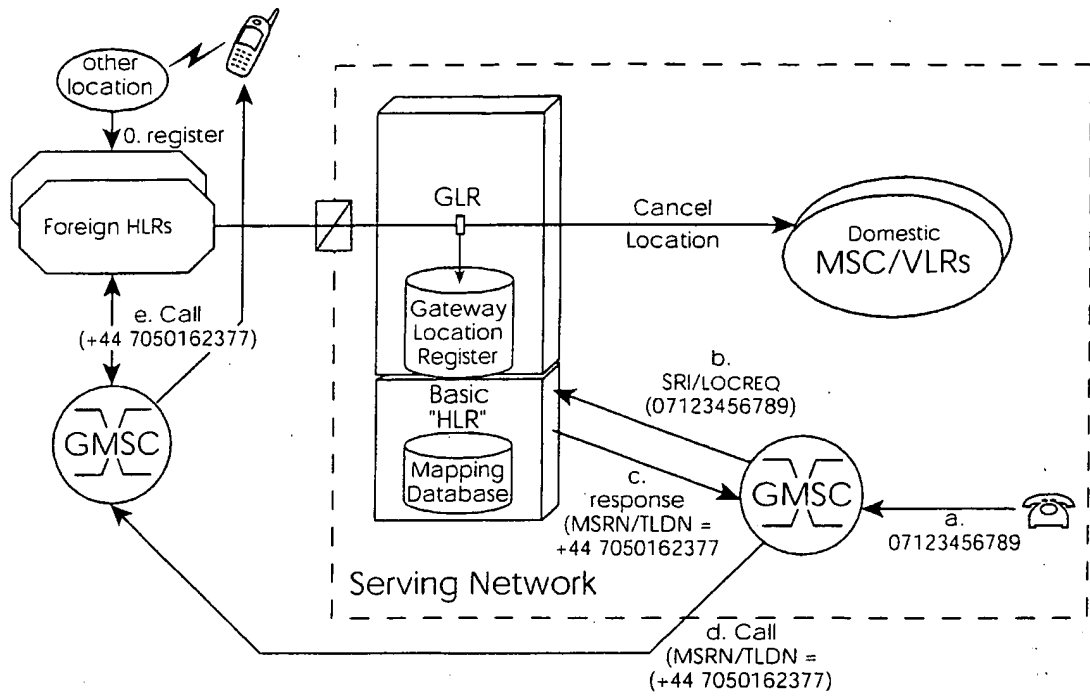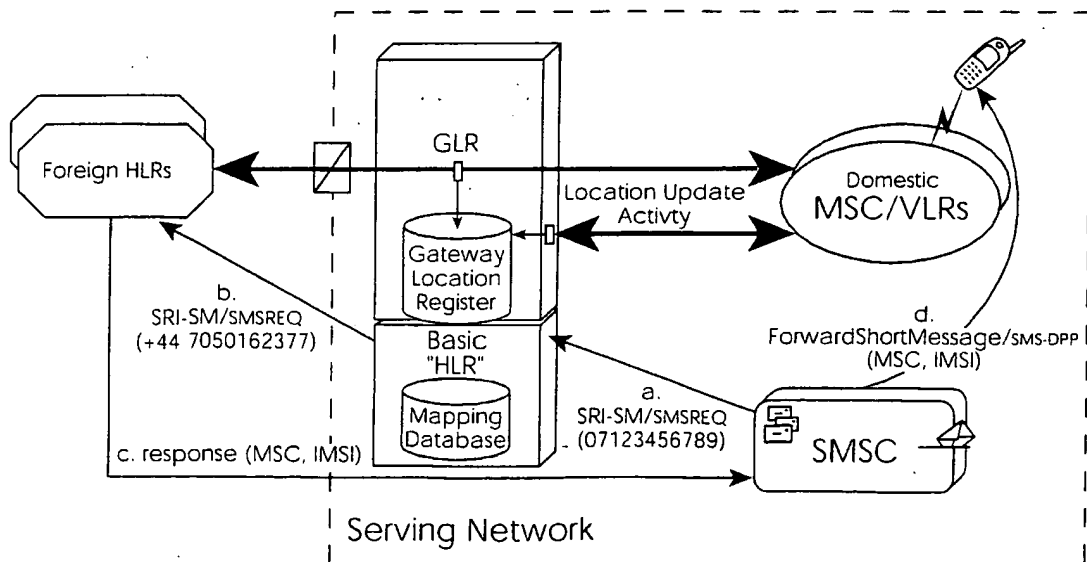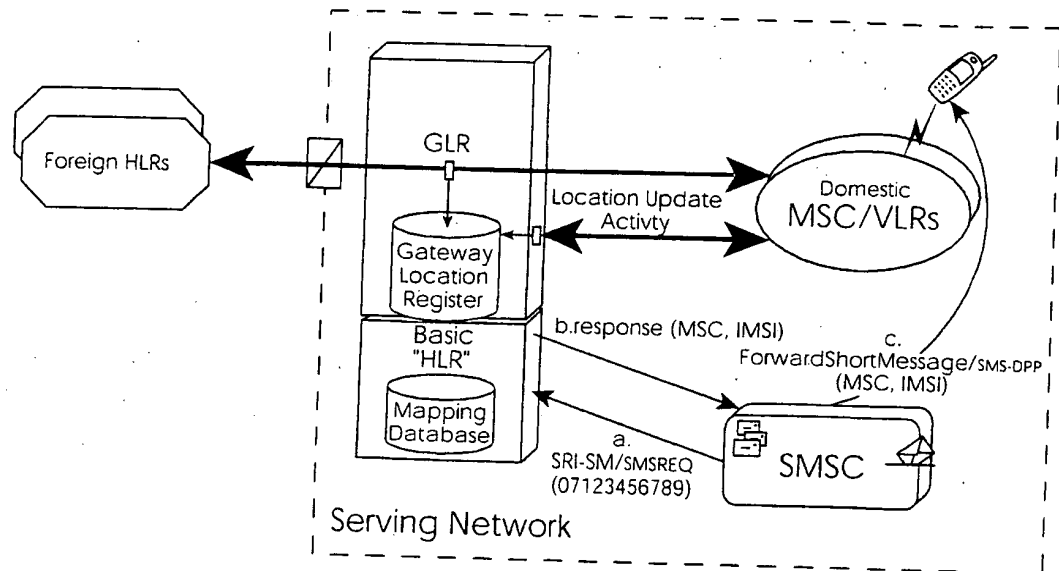
Fig. 1

Fig. 2

Fig. 3

Fig. 4
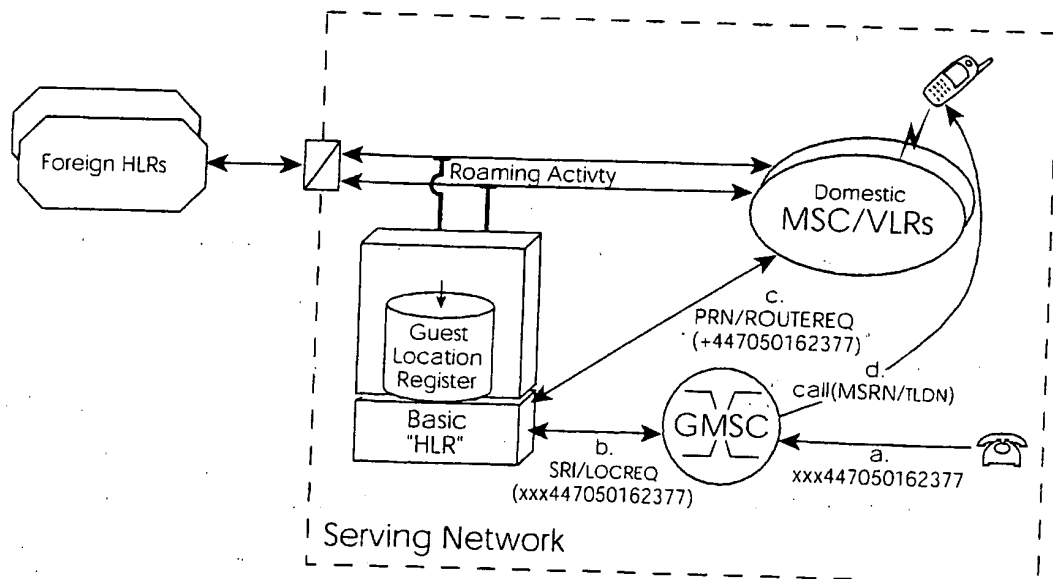
Fig. 5

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7   H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 832 382 A (ALPEROVICH) 3 November 1998 (1998-11-03) column 4, line 66 -column 5, line 22 column 9, line 1 - line 2 column 7, line 45 - line 56 ---	1,3,4,6, 10,13,15
X	WO 99 59371 A (ERICSSON INC) 18 November 1999 (1999-11-18) page 7, line 16 - line 31	1,8,13, 15
Y		4,6,7,9

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[X] Further documents are listed in the continuation of box C.   [X] Patent family members are listed in annex.

° Special categories of cited documents :

'A' document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
5 July 2001	20/07/2001

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	LANTTO J: "ROAMING BETWEEN CELLULAR STANDARDS" PROCEEDINGS OF THE INTERNATIONAL SWITCHING SYMPOSIUM,DE,BERLIN, VDE VERLAG, vol. SYMP. 15, 23 April 1995 (1995-04-23), pages 241-245, XP000495572 ISBN: 3-8007-2093-0 page 242, right-hand column, line 1 -page 243, left-hand column, line 11 page 244, right-hand column, line 9 - line 24 page 244, left-hand column, line 26 -right-hand column, line 7 -----	4,6,7,9

2

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 5832382	A	03-11-1998	AU	4421097 A	02-04-1998
			BR	9711467 A	24-08-1999
			WO	9811753 A	19-03-1998
WO 9959371	A	18-11-1999	AU	3555499 A	29-11-1999

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